Lecture 34

CSE 331

Nov 20, 2024

Reflection 2 has been graded

note @304 stop following 28 views

Actions

Reflection 2 has been graded

Reflection problem 2 has now been graded and the scores and feedback released on Autolab! Hopefully the feedback is helpful as y'all work on your Reflection Problem 3.

PLEASE READ THE RUBRIC CAREFULLY TO SEE THE COMMON MISTAKES, which y'all should avoid making for future reflection problem submissions. *Also take a look at the feedback since in many cases I did not deduct points since this was the first submission where we have asked you to think about implications of your algorithm-- the grading would be stricter reflection 3 onwards.*

Few common mistakes:

- *In argument for in favor vs not: not clearly stating why your algo idea leads to the claimed group being favored vs. not*
- *Not explicitly taking the routing algorithm in your argument.*
  - *Just because your algorithm picked certain paths in certain priority, it does not mean that has to play "nice" with the routing algo-- so your argument should explicitly state why you expect (at least a high level) the routing algo to not completely undo the priority in your algo.*
- *The algo idea not matching the code that was submitted.*
- *More generally, your document should be self-contained. So if you state your algo generates path that prioritizes certain types of clients, you should state* explicitly how *your algo implements that.*

(Please see the re-grade policy as well as the grading rubric below before contacting us with questions on grading.)

HW 8 is out (due in TWO weeks)

Homework 8

Due by **11:30pm, Tuesday, December 3, 2024**.

Make sure you follow all the homework policies.

All submissions should be done via Autolab.

Check the week 13 recitation notes for this homework.

The support page on SAT solvers could be useful for Question 3.

How are graphs represented in Q1 and Q2?

It does not matter: you can assume either the adjacency list representation or the adjacency matrix representation-- whatever is more convenient for y'all.

Question 1 (Clique problem) [50 points]

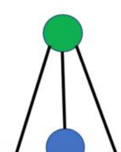
In this problem, we will consider a problem that is essentially the "complement" of the independent set problem. Given a graph $G = (V, E)$, a *clique* is a subset $S \subseteq V$ such that **all** $\binom{|S|}{2}$ edges between the vertices in S exist. As we have done in class, we consider the following *decision* version of the problem of finding the *largest* clique in a graph

The problem

Given a graph G and a number k, does G contain a clique of size at least k? I.e. does there exists a subset $S \subseteq V$ such that $|S| = k$ and there are all possible $\binom{k}{2}$ edges present among the vertices in S?

Sample Input/Output pairs

For the sample inputs, let us consider the following graph, which we will call G_0:



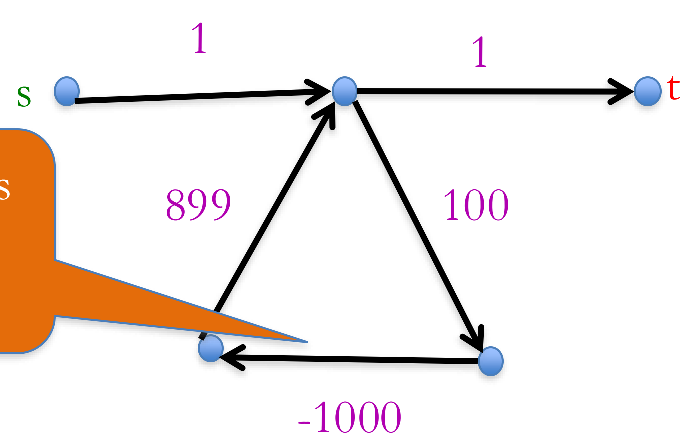
Questions?

Shortest Path Problem

Input: (Directed) Graph $G=(V,E)$ and for every edge e has a cost c_e (can be <0)

t in V

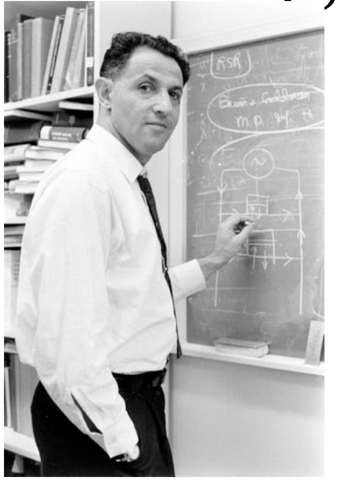
Output: Shortest path from every s to t



Shortest path has cost negative infinity

Assume that G has no negative cycle

When to use Dynamic Programming



Richard Bellman

There are polynomially many sub-problems

Optimal solution can be computed from solutions to sub-problems

There is an ordering among sub-problem that allows for iterative solution

Questions?

Today's agenda

Bellman-Ford algorithm

Analyze the run time

Algo on the board…

The recurrence

OPT(u,i) = shortest path from u to t with at most i edges

$$OPT(u,i) = \min \left\{ OPT(u,i-1), \min_{(u,w) \text{ in } E} \{ c_{u,w} + OPT(w, i-1) \} \right\}$$

Some consequences

OPT(u,i) = cost of shortest path from u to t with at most i edges

$$\mathrm{OPT}(u,i) = \min \left\{ \mathrm{OPT}(u, i\text{-}1), \min_{(u,w) \text{ in } E} \left\{ c_{u,w} + \mathrm{OPT}(w,i\text{-}1) \right\} \right\}$$

OPT(u,n-1) is shortest path cost between u and t

How to compute the shortest path between s and t given all OPT(u,i) values

Bellman-Ford Algorithm

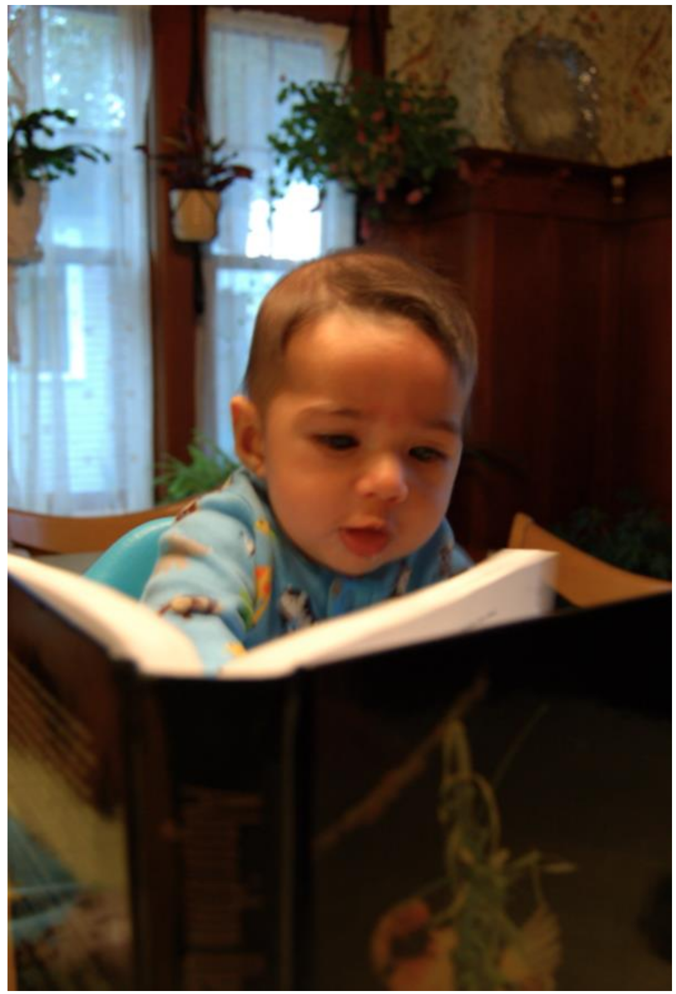
Runs in $O(n(m+n))$ time

Only needs $O(n)$ additional space

Questions?

Reading Assignment

Sec 6.8 of [KT]



Longest path problem

Given G, does there exist a simple path of length $n-1$?